Hydroponic Rego-rock Produced In-Space for Efficient and Healthy Crop Growth, Phase I

Completed Technology Project (2018 - 2019)

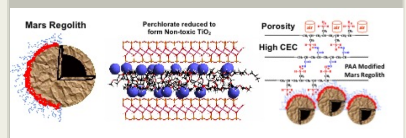
Project Introduction

In support of NASA's goals for efficient plant growth in Space, NanoSonic offers an inert polymeric binding system to make use of Mars surface regolith as a safe, structural, growth media for passive hydroponically grown plants. Importantly, the proposed multi-functional binding agent will be combined with regolith to: 1) form a porous support structure with an optimal air-to-water ratio for enhanced water/nutrient retention, 2) result in a high cation exchange media for long-term availability and uptake of mineral nutrients to the plants, while precluding anionic perchlorate sorption, and 3) chemically reduce regolith-containing perchlorate compounds to non-toxic TiO_2 crystallites. This low weight, low volume pelletized binding system will take advantage of surface structure available on Mars that cannot be used alone in its current perchlorate laden form, and thereby reduce the amount of growth media and fertilizer required in transit to Space. During this program, NanoSonic shall produce prototype "Rego-rock", based on our innovative polymer structural reinforcement system for Mars-like regolith. We have teamed with water purification and hydroponic plant experts at Virginia Tech (VT) and Groundworks to demonstrate soil-less growth of non-toxic nutrient rich plants with our innovative Rego-rock. Specifically, Dr. Jason He, VT's Director of Center for Applied Water Research and Innovation (CAWRI), shall characterize water flux, uptake, and purity of Rego-Rock tested in forward osmosis units to assess lifetime and potential for re-usability after cleaning. Groundworks will grow plants hydroponically within Rego-rock alongside unmodified Mars-like regolith and a commercial growth media to yield produce for toxicology and quantify anticipated enhanced growth rate and yield.

Anticipated Benefits

NanoSonic shall develop an innovative polymeric binding agent that will enable Mars surface regolith as a safe and efficient grow media for hydroponic produce grown on Mars. The binding agent will remove toxic perchlorate compounds from Mars regolith rendering it a suitable substrate to reduce the amount of prepackaged food, plant seeds, and fertilizer needed in transit and during astronauts stay at the Red Planet. Our initial customer will be NASA in support of the Veggie program.

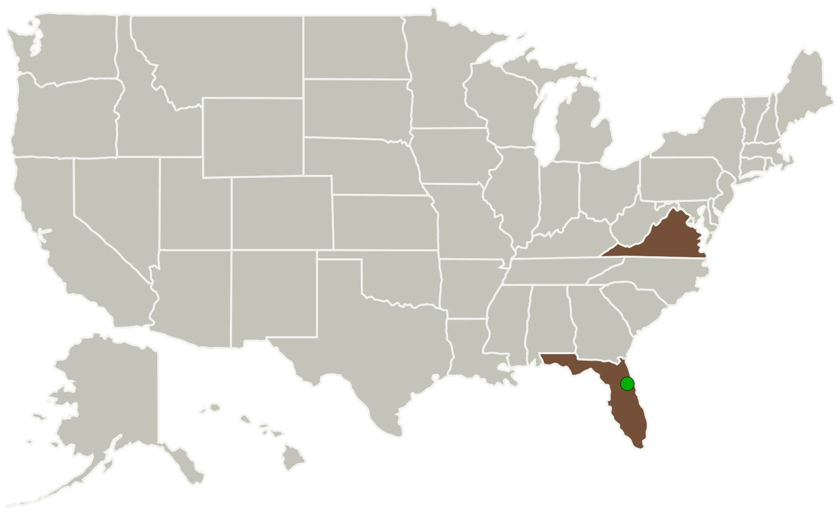
NanoSonic's methods to render Mars regolith a suitable growth media shall also advanced the state-of-the-art in commercial terrestrial grow media. Rego-rock technology shall enhance the cation exchange capacity of the growth media which will allow for the long-term uptake of nutrients. The enhanced porosity will allow for an optimal air-to-water ratio. Additional markets for the Rego-rock technology is in the terrestrial hydroponics markets as well as agriculture, stormwater, and wastewater.



Hydroponic Rego-rock Produced In-Space for Efficient and Healthy Crop Growth, Phase I

Table of Contents

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Nanosonic, Inc.	Lead Organization	Industry	Pembroke, Virginia
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
Virginia Polytechnic Institute and State University(VA Tech)	Supporting Organization	Academia	Blacksburg, Virginia

Primary U.S. Work Locations	
Florida	Virginia

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nanosonic, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

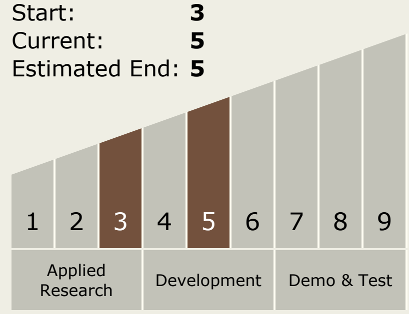
Carlos Torrez

Principal Investigator:

Jennifer Lalli

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**

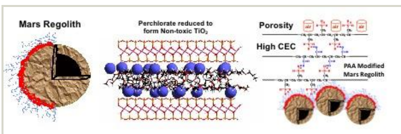


August 2019: Closed out

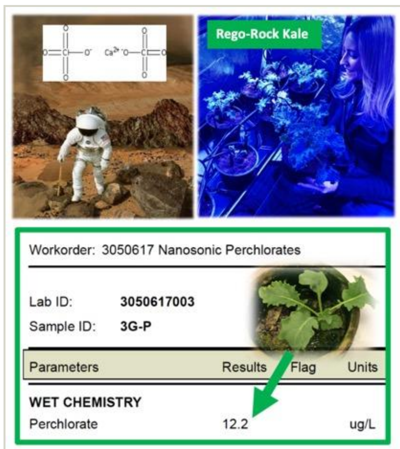
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141824)*

Images



Briefing Chart Image
Hydroponic Rego-rock Produced In-Space for Efficient and Healthy Crop Growth, Phase I
(https://techport.nasa.gov/image/131569)



Final Summary Chart Image
Hydroponic Rego-rock Produced In-Space for Efficient and Healthy Crop Growth, Phase I
(https://techport.nasa.gov/image/130320)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - └ TX07.1 In-Situ Resource Utilization
    - └ TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destination

Mars